Abstract

Resistance of Size-Quantized Inhomogeneous Films

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Investigations of transport phenomena in low-dimensional systems such as size-quantized films or quantum wells have attracted much attention recently. As a rule short-range models of impurity potential are used to treat the carrier scattering. Meanwhile, there are 2D-systems (films) where nanoscale inclusions may be embedded. In the present work we have investigated the resistance of the inhomogeneous 2D-systems with long-range scatterers. As a model of the 2D-system is considered the size-quantized film in which two-dimensional electron gas with a two-dimensional subband structure is formed. It is assumed that in 2D-systems there are nanocenters (for instance, hetero phase inclusions or quantum dots). In this case extended states of the 2D-system may be interfered with localized states of nanocenters. The resonances caused by the coupling of the extended states of the two-dimensional subband with the localized states of the nanocenters are predicted. It is demonstrated that the finite size nanocenters give rise to a series of quasi-localized states, which manifest themselves as resonance-antiresonance pair in the cross sections and in the residual resistance. It is shown that the characteristic of resonances determine the magnitude of the configuration coupling of different states in quantum films (A. M. Satanin and V. B. Shtenberg, JETP Letters, Vol. 75, No 3, 146 (2002)). The resonance contribution to the resistance can be revealed, e.g., by the dependence of the resistance on the position the Fermi level.

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